Implementing an EMR: Paper's Last Hurrah

David N. Mohr, M.D., Paul C. Carpenter, M.D., Paul L. Claus, M.D.,
Philip T. Hagen, M.D., Philip R. Karsell, M.D., Robert E. Van Scoy, M.D.
Mayo Clinic, Rochester, Minnesota

The implementation of an electronic medical record system in any large organization is as complex a task as the design of the system. During implementation, it is necessary that health care providers using the electronic system are able to communicate with colleagues who are continuing to work with the paper record. The Mayo Clinic in Rochester, Minnesota, is well along the path to implementing an electronic medical record system. One of the key issues addressed has been the need for the electronic system to integrate with the paper record. This need to function in the dual electronic/paper environment has placed new demands on printers, required revision of some paper forms, and required the electronic system to create facsimilies of paper record forms. In addition, new security issues have been raised. Dual paper/electronic environment issues are an important challenge in the implementation of an electronic medical record.

INTRODUCTION

The implementation of an electronic medical record (EMR) system in a large organization is a complex process. It requires a needs assessment, a strategic plan, translation of this plan into projects, training, and implementation. The implementation of this system involves many people and can span a large geographic area including floors of a single building and various practice sites.

There are many advantages to implementing such a system in a graduated fashion across the organization. At the least, a pilot site must be targeted where issues can be resolved that may not have been identified during usability tests. If rapid software development is available, gradual implementation allows new features to be added and software to be customized as implementation reaches different areas without delaying the start date of the project until the entire plan is complete.

An EMR system can be constructed in a modular fashion The core modules include clinical notes, results, orders, patient provided information, and problems. In a similar way to a gradual implementation geographically across an organization, an electronic medical record can be implemented gradually by modules. For a complicated electronic record system, this allows each of the implementation teams to concentrate on the issues related to one module.

Both of these implementation schemes require that some caregivers in an organization be operating in an electronic environment while others are in the paper environment. During a lengthly implementation phase, it is imperative that patient care and communication between providers occur unimpeded by the new system. One solution to this is to have review-only work stations at every site of care so that those functioning in the paper world retrieve information electronically from their colleagues in the "electronic environment." This solution would require training of those in the paper world before they were actually entering data in the system and would require an expensive work station committment early in the implementation process. A better approach is to require each of the electronic systems to produce a concurrent record that fits seamlessly with the existing paper record system. In this way, those not yet involved in the implementation do not require any training.

There is very little guidance in the literature on EMR implementation. Categories such as information infrastructure and integrated clinical information systems at national meetings (1,2) do contain presentations which deal with practical issues and enterprise-wide systems. These articles, however, usually focus on issues related to the electronic world in a hospital-wide system (3) or the planning of an enterprise-wide infrastructure necessary for implementation (4).

The Mayo Clinic in Rochester, Minnesota, has completed a substantial part of the implementation of an electronic record system. Although multiple implementation issues warrant discussion, this paper will focus on the issues related to communications between health care providers in the paper world and those in the electronic phases of implementation. These issues relate to systems existing in a dual paper/electronic environment.

BACKGROUND

Strategic planning for an EMR at Mayo Rochester began in 1988. At that time, a project linking laboratory results from many source systems to a common database was initiated and work stations began appearing in clinical sites for viewing results by 1990. An EMR planning task force began in 1992 to define the electronic medical record system

0195-4210/95/$5.00

that would be required and the institutional structure needed to bring this about. In 1993, an electronic medical record task force was formed, a strategic plan was developed, and the modules of an electronic medical record were defined. Committees were formed which carried out the detailed planning of the module requirements and their interaction with an overall electronic medical record system.

The basic tenants of the core modules were that they must serve as building blocks for the future EMR, that they most promote efficiencies in their own rights as stand-alone projects and thus be financially viable, and finally, they must allow a gradual implementation throughout the Clinic and thus must be able to function in a dual paper/electronic environment. The modules can be briefly defined as follows:

1) Results Module. This module collects laboratory reports from various source systems and presents them to users on work stations or printed sheets if work stations are unavailable. The printed sheets include temporary cumulative summary forms, temporary customized summary forms, and permanent comprehensive summaries of all laboratory reports beginning in 1993. Currently there are 1600 work stations and 1200 printers distributed through the Clinic and associated hospitals. Users select a patient or a list of patients to review, results to be viewed, a time frame for viewing, and printed page or video display viewing.

2) Clinical Notes. This module captures and stores notes related to patient care and allows retrieval of these notes on clinical work stations or printers. This system supports and has allowed the reengineering of the correspondence process. It allows the collection of encounter-based problems. Finally, it collects service recognition information. There are two fundamental screen presentations, one for health care providers which allows direct note entry and also efficient edit and review functions. The other is a transcriptionist view which maximizes transcription efficiencies.

3) Patient Provided Information. This module collects, stores, and displays information traditionally entered directly by a patient. This includes such categories as past histories, family histories, allergies, medications, and review of systems. This can be provided by the patient prior to the encounter with a health care provider. A variety of collection tools including scannable forms and interactive devices are being used.

4) Master Sheet/Problems. Mayo's current paper "Master Sheet" is a high level summary of all clinical diagnoses addressed during episodes of care at the Mayo Clinic. It has traditionally served as a cover sheet and an index to the patient history as a collection of diagnostic statements. It is also used for research and coding. This module of the EMR provides an online list of master sheet entries for patient care purposes. It has simplified the process of entry of items to the Master Sheet and will be closely integrated with a future problem module.

5) Orders. The Orders module supports efficient work station based order entry at the site of care. This includes orders for tests, procedures, consultations, medications, and appointments. Prescription printing is also supported. Service recognition is supported in areas where Clinical Notes is not available.

DUAL ENVIRONMENT ISSUES

1) Results.
In the first phase, result slips printed by the source systems and distributed by paper throughout the Institution were replaced by a system in which results were printed on demand at clinical care sites. The second phase occurs when work stations are placed directly in the exam rooms within a particular site. In phase one, the on-demand feature was used by outpatient desk attendants before patients were placed in rooms and by hospital nursing station secretaries before morning rounds and in some locations twice daily. In addition, on-demand printing is quite popular with resident physicians who could carry results with them on rounds and by medical secretaries who could include results in special formats for referring physician letters. The popularity of ad hoc printing, however, has flooded the system with print requests. Currently, reports for approximately 9000 patients are printed daily.

Because the first phase of the project involved the shifting of print activities from an automatic central institutional site to peripheral locations where they were printed on demand, printer maintenance has been a challenge.

Security issues associated with the disposal of these temporary reports have been another challenge. If reports containing confidential information are found at inappropirate sites, they are sent to a central location and the specific user whose name is printed on the report is contacted about proper disposal. Although sensitive tests such as pregnancy tests syphilis serologies, etc. require additional steps to view and print, they present additional security challenges.

The final issue in the Results Module is not so much related to the dual environment requirements, but rather to the fact that on-demand printing is used instead of the previous automatic printing of source system slips. The slips had served as reminders of data needing to be seen, and they were routed to the responsible physician if they arrived after patient dismissal from an episode of care. With on demand printing, however, mailed-in, delayed, revised, and amended reports required a different system. The solution was a "status flag" from each of the laboratory source systems for reports that were mailed in, delayed, revised, or amended so that a new notification procedure could be instituted.

2) Clinical Notes

The format, paper size, and distinctive features on the border that allow easy recognition of notes written by different specialties was carried over from the paper record system to the notes printed by the electronic notes system.

Note continuity within a dual system is managed by asking those entering notes to provide pointers in the handwritten record even if they are entering notes electronically. In this way, a continuous document of clinical care is available in the handwritten section even though some providers are in the electronic world. These electronical generated documents are stored as separately numbered sheets in the paper record.

This system creates separate sheets of paper for each electronic note, thus allowing originals to be replaced by revisions without disrupting the sequence of subsequent handwritten notes.

Areas using complex figures requring handwritten annotation have separated these sections from the narative portion of their notes. The annotated versions are kept in the handwritten form. These will be accommodated in the electronic version in the future.

Centralization of the printing function and page management was made possible by the electronic system. Although it has caused extreme demands on high-speed printers, additional print burdens would have occurred at peripheral secretarial sites as more notes were dictated in response to simple legibility issues.

Because the system allows replacement of sheets that have been edited, this module also presents the security issue of disposal of sheets.

3) Patient Provided Information

The need to function in a dual paper/electronic environment has placed significant burdens on the patient provided information system. It is complex enough to collect information from a patient, store it in a database, and allow the physician or caregiver to review and edit the information electronically. Performing the activity in locations where there are no work stations yet available on which to edit information, or providing the most recent copy to colleagues not yet on the system is even more complex.

The current patient questionnarie has been reformatted to a scannable format to improve its usability. A copy of the current paper version of this information is recreated electronically and printed in a form nearly identical to that used in the other nonautomated areas of the Clinic and hospitals. To achieve this, patient's answers are retrived from the answers database and "overprinted" on the postscript form image to recreate the medical record copy. This copy is designated as an electronic version of the current form. The form will be retained in the same location in the chart as similar hand-completed copies from nonautomated areas of the Clinic.

A condensed version of the information can be retrieved in standard clinical format (past medical history, family history, social history, etc.) and printed in a temporary form in areas without clinical work stations if they have printer access. These forms can be used to help caregivers complete other paper forms to avoid reasking the patient these questions if the paper history is not available.

Challenges to the implementation include transcribing ongoing "edits" of the online verions of the patient provided information to paper, tracking page or version numbers, returning "previous" answers to patient with or without edits at future visits. An additional challenge for the electronic system is the capture of patient signatures to authorize information release so that areas in the paper world know this has been obtained.

A solution for data concurrency in the paper and electronic world is that annotations can be made to Patient Provided Information by the physician seeing the patient prior to printing the permanent copy. Thus, the majority of changes will be collected before a paper version is created. Further annotations by other care providers in nonelectronic areas must be made in their clinical notes or manually in the paper record copy. These would have to then be converted at a later date to the electronic version if the database is updated.

4) Master Sheet

As a cumulative summary, the Master Sheet presents several challenges in the dual environment. Until electronic work stations are ubiquitous, the paper record must contain a complete record of all Master Sheet entries at all times. Thus, traditional manual entries and computer generated electronic entries must coexist in the history. To deal with this, a "manual temporary sheet" has been introduced which is completed by hand. For those areas using electronic entry, a stamp is made on this manual sheet indicating that an "electronic temporary sheet" exists. These "electronic temporaries" (which are half sheets) are tucked into "manual temporaries" (which are full sheets). During the phase in, the number of electronic temporaries will increase while the number of manual entries will decrease. At the end of the patient's episode of care, all temporaries will be combined into an "electronic master sheet summary report" which will replace the temporaries in the chart. Once all entries are made electronically and EMR work stations are at all care locations, it will be possible to replace the paper system with a fully electronic, paperless master sheet. In the meantime, for those areas not using electronic entry, our Medical Information Resource Division transcribes the manual master sheet entries into the master sheet database after the episode of care.

5) Orders

A list of ordered tests and consultations and preferences for scheduling future appointments is printed after physician selection of these items at the work station. This list replaces a form on which selected tests are indicated in the paper record. Referral cards which carry additional information about ordered tests or consultations as collected from the electronic system are printed. These are similar to those in the paper world and are currently routed in a way similar to the forms in paper-only areas. Thus, patient care in nonelectronic areas continues with full information about ordered tests, and sites where tests are performed receive similar information whether the encounter was electronic or paper-based.

CONCLUSION

The implementation of an electronic record system is a highly complex process. Implementation is facilitated by having a system that allows one group or part of the group to move to the electronic world without disrupting communication with colleagues in the paper world. It is also facilitated by having a modular system in which groups can specialize in implementation of particular modules of the EMR.

Many issues arise from the need for these systems to exist in a dual paper/electronic environment. Printer demand at patient care sites is significantly increased. In the Results module, the need to change to on-demand printing has required the peripheralization of the results printing process. This has created a large network of printers and a large volume of temporary printed reports. The increase in volume of clinical notes relates mostly to the change from hand-written to printed notes. The centralized data base actually allows some centralization of printing function from secretarial sites to a common desk location. Compared to a system using hand-written notes, however, printing is a significant issue in this module. New printing requirements exist in the Orders module where it was necessary to print referral cards and ordered tests lists at the patient care sites. These had been batch printed elsewhere in the paper record system. In the Patient Provided Information module the electronic system prints versions similar to those preprinted in batch form for the paper record. Finally, Master Sheet entries which had previously been typewritten, can now be entered electronically and printed and stored in the chart with similar appearing manually created versions in the dual environement.

A second common feature for these modules in the dual environment is the need to create equivalent formats. Physicians functioning in areas without the electronic systems will not be trained in new forms and therefore will need to see familiar formats. We created printed clinical notes that clearly reflect the specialty type in a way similar to the paper record. The Patient Provided Information forms are also over printed on the current versions. Master Sheet formats are essentially the same, and the electronic Orders ordered test format is actually a condensed version of annotations on a preprinted form in the existing paper record.

New systems had to be created for several of the modules. An example of this are the pointers in the handwritten note that send the user to the electronic version. Similarily, an automatic numbering system in the electronic notes was required. In the Master Sheet module, the concept of a temporary Master Sheet that would exist until the end of an episode of care was created.

Finally, new security issues have arisen. In the Results module, the on-demand requirement has created temporary copies of patient information that required special notation of the person responsible for the printing to help avoid security risk. The need to remove clinical notes for revisions was an additional new demand that required proper disposal of the old note that had been amended.

These issues are not insurmountable and are more than compensated by the flexibility of the

implementation process. Patient care continues unimpeded by the introduction of electronic systems, and these electronic systems can be gradually improved before the paper record is no longer the archival respository and the patient care environment becomes totally dependent on electronic systems.

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